

Amended Disclosure
submitted October 2007

Please enter the amendments to paragraphs [0028], [0034], [0037], [0038], [0051], [0057], as follows.

[0028] The cooling system of which the pump of Fig 1 is a component is of the type in which coolant circulates at all times through the heater (Fig 6). (In other types of cooling system, flow may be sometimes, in operation, diverted to by-pass the heater.) In Fig 6, the impeller of the pump P is driven e.g by means of a geared drive, or by means of a belt drive 241, directly from the engine E. In Fig 6, when the coolant is warmed up, the coolant circulates around the radiator R; when the coolant is cold, coolant cannot circulate around the radiator R, because the swirl-vanes 234 in the pump P lie in a fully-closed position, thus closing off the radiator-port 237. The temperature-sensing bulb in the thermostat-unit 235 is positioned appropriately to measure the temperature of the coolant coming from the engine E (and, or via, the heater H) just before the coolant enters the pump P. As shown in ~~Fig 4~~ Fig 3, there is a passage 248 between the heater port 238 and the bulb, whereby the bulb is flooded with incoming coolant.

[0034] After that, once the coolant has warmed up, the temperature of the coolant varies in accordance with driving conditions, vehicle loading, ambient temperature, etc; as the coolant becomes hotter, or becomes less hot, the swirl-vanes vary as to their orientation, in accordance with the coolant temperature, in the manner as described in the publications. Again, the designer should arrange that, once the coolant is up to normal running temperature, the angle the swirl-vanes 234 adopt when the coolant is at its hottest gives the greatest boost to the flowrate, whereas the angle the vanes adopt when the coolant is at the cooler end of its range of normal-running temperatures gives the greatest reduction (or, it may be termed, gives the smallest boost) to the normal-running flowrate. Typically, the minimum normal-running flowrate may be of the order of a half of the maximum normal-running flowrate, at a typical pump speed and operating condition. In Fig 1 the impeller 136 rotates in ~~an anti-clockwise~~ a counter-clockwise direction, whereby the above manner of operation obtains.

[0037] It will be noted from Fig 1 that the swirl-vanes 234 (numbering thirteen swirl-vanes in this

case) do not completely surround the impeller 236. A sector of the circumference of the impeller is left open, being the sector communicating with the engine/heater inlet port 238, i.e the flow that by-passes the radiator during warm-up. Thus, even when the swirl-vanes are fully closed (Fig 4a), it is only the radiator port 237 that is blocked, not the by-pass port 238. When the coolant is cold enough for the radiator to be blocked the flowrate passing through the engine is quite small, which is reflected by the fact that this flow occupies only a small sector [233] of the circumference of the intake of the impeller. The full HOT flowrate passing through the radiator will be many times greater than the low flowrate of the by-pass flow passing through just the engine/heater in the COLD condition.

[0038] The swirl-vanes are most effective when they are arranged to completely, or almost completely, surround the intake of the impeller. If some of the flow entering the impeller has not been through the swirl-vanes, then the flowrate is not being fully and completely controlled responsively to the swirl-vanes, i.e responsively to the temperature-dependent orientation of the swirl-vanes. Preferably, the designer should see to it that as much as possible of the warmed-up flow of coolant passes through the swirl-vanes. In other words, the sector [233] of the impeller circumference that receives incoming flow from the engine, during warm-up from cold, should be minimal. The full flowrate from the radiator under HOT conditions preferably should occupy eighty or ninety percent of the circumference of the intake to the pump impeller; and should occupy at least about sixty percent of the circumference, as a minimum.

[0051] The open interior conduit 258 of the slider 257 has a radially-outwards-facing opening 259. This opening 259 connects with the radiator-port 256 when the slider 257 is to the right. Coolant enters the pumping-chamber 254 from the radiator, and passes to the pump impeller 260. The radiator-port 256 is blocked when the coolant is cold (upper-half of Fig 9) and open when the coolant has warmed up (lower-half of Fig 9).

[0057] Inside the pump chamber 254 is a thermostat unit 275. The unit 275 is conventional, in itself, and includes a bulb which expands as it heats, driving a stem 276 out of the thermostat casing 278. The casing is a press fit inside the slider 257. [~~Again,~~ Again, it will be understood that a thermally-controlled movement-actuator other than a traditional wax-type thermostat may be provided, e.g an electrical linear actuator coupled to a thermal sensor, for the purpose of moving the ~~slider~~ slider.